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<120> Membrane-Bound Desaturases

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<140> US/09/857,524
<141> 2002-06-21

<150> 60/110,784
<151> 1998-12-03

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<213> Picramnia pentandra

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35 40 45

Ser Phe Ala Gly Gln Asp Val Thr Asp Ala Phe Ile Ala Tyr His Pro
50 55 60

Gly Thr Ala Trp Gln Tyr Leu Asp Arg Phe Phe Thr Gly Tyr Tyr Val
65 70 75 80

Gln Asp Tyr Ser Val Ser Glu Met Ser Lys Asp Tyr Arg Arg Leu Val
85 90 95

Ser Glu Phe Ser Lys Met Gly Leu Phe Lys Thr Pro Gly Lys Gly Val
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Tyr Cys Ser Ile Phe Phe Val Ser Val Leu Phe Ala Leu Ser Val Tyr
115 120 125

Gly Val Leu Tyr Cys Lys Ser Thr Trp Ala His Leu Cys Ser Gly Leu
130 135 140

Leu Met Gly Met Leu Trp Leu Gln Ser Gly Trp Val Gly His Asp Ser
145 150 155 160

Cys His Tyr Gln Val Met Pro Asn Arg Lys Leu Asn Arg Leu Phe Gln
165 170 175

Ile Ile Ala Gly Asn Val Ile Ala Gly Val Ser Val Ala Trp Trp Lys
180 185 190

Leu Asp His Asn Thr His His Phe Ala Cys Asn Ser Ala Asn Leu Asp
195 200 205

Pro Asp Ile Gln His Leu Pro Ile Ile Ala Ile Ser Pro Lys Phe Phe
210 215 220

Asn Ser Leu Thr Ser Tyr Tyr His Asn Cys Lys Met Thr Tyr Asp Arg
225 230 235 240

Ala Ala Arg Phe Phe Val Ser Phe Gln His Trp Thr Phe Tyr Pro Ala
245 250 255

Leu Leu Ser Val Arg Leu Tyr Leu Phe Ile Leu Ser Phe Lys Val Val
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Phe Ser Asn Asn Lys Arg Val Tyr Lys Arg Ser Gln Glu Ile Leu Gly
275 280 285

Tyr Ala Ala Phe Leu Thr Trp Tyr Ser Leu Leu Leu Ser Arg Leu Pro
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Asn Trp Pro Glu Arg Val Met Tyr Phe Thr Ser Cys Leu Ala Val Ala
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Gly Phe Gln His Trp Gln Phe Ser Leu Asn His Phe Ala Ser Asn Val

325 330 335

Tyr Thr Gly Leu Pro Ser Gly Asn Asp Trp Phe His Gln Gln Thr Lys
340 345 350

Gly Thr Leu Asn Ile Thr Ala Ser Ala Trp Trp Asp Trp Phe His Gly
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Gly Leu His Phe Gln Ile Glu His His Leu Phe Pro Arg Met Pro Lys
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Cys His Phe Arg Lys Ile Ser Pro Ile Val Asn Lys Leu Cys Gln Lys
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His Asn Leu Ser Tyr Glu Thr Ala Thr Met Trp Glu Ala Asn Lys Met
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Val Tyr Ser Thr Leu Arg Ala Val Ala Met Glu Ala Lys Asp Val Thr
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<211> 462
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Thr Pro Trp Leu Pro His His Pro Gly Gly Asp Leu Pro Leu Leu Thr
     50                  55                  60

Leu Ala Gly Gln Asp Ala Thr Asp Ala Phe Ala Ala Tyr His Pro Pro
 65                  70                  75                  80

Ser Ala Arg Pro Leu Leu Arg Arg Phe Phe Val Gly Arg Leu Ser Asp
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Tyr Ala Val Ser Pro Ala Ser Ala Asp Tyr Arg Arg Leu Leu Ala Gln
            100                 105                 110

Leu Ser Ser Ala Gly Leu Phe Glu Arg Val Gly Pro Thr Pro Lys Val
        115                 120                 125

Gln Leu Val Leu Met Ala Val Leu Phe Tyr Ala Ala Leu Tyr Leu Val
    130                 135                 140

Leu Ala Cys Ala Ser Ala Trp Ala His Leu Leu Ala Gly Gly Leu Ile
145                 150                 155                 160

Gly Phe Val Trp Ile Gln Ser Gly Trp Met Gly His Asp Ser Gly His
                165                 170                 175

His Arg Ile Thr Gly His Pro Val Leu Asp Arg Val Val Gln Val Leu
            180                 185                 190

Ser Gly Asn Cys Leu Thr Gly Leu Ser Ile Ala Trp Trp Lys Cys Asn
        195                 200                 205

His Asn Thr His His Ile Ala Cys Asn Ser Leu Asp His Asp Pro Asp
    210                 215                 220

Leu Gln His Met Pro Leu Phe Ala Val Ser Pro Lys Leu Phe Gly Asn
225                 230                 235                 240

Ile Trp Ser Tyr Phe Tyr Gln Arg Thr Leu Ala Phe Asp Ala Ala Ser
                245                 250                 255

Lys Phe Phe Ile Ser Tyr Gln His Trp Thr Phe Tyr Pro Val Met Cys
            260                 265                 270

Ile Ala Arg Ile Asn Leu Leu Ala Gln Ser Ala Leu Phe Val Leu Thr
        275                 280                 285

Glu Lys Arg Val Pro Gln Arg Leu Leu Glu Ile Ala Gly Val Ala Thr
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Glu Arg Val Ala Phe Val Leu Phe Ser Phe Thr Ile Cys Gly Ile Gln
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His Val Gln Phe Cys Leu Asn His Phe Ser Ser Asp Val Tyr Val Gly
            340                 345                 350

Pro Pro Lys Gly Asn Asp Trp Phe Glu Lys Gln Thr Ala Gly Thr Leu
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Asp Ile Leu Cys Ser Pro Trp Met Asp Trp Phe His Gly Gly Leu Gln
    370                 375                 380

Phe Gln Ile Glu His His Leu Phe Pro Arg Leu Pro Arg Cys His Leu
385                 390                 395                 400

Arg Lys Val Ala Pro Ala Val Arg Asp Leu Cys Lys Lys His Gly Leu
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Thr Tyr Ser Ala Ala Thr Phe Trp Gly Ala Asn Val Leu Thr Trp Lys
            420                 425                 430

Thr Leu Arg Ala Ala Ala Leu Gln Ala Arg Thr Ala Thr Ser Gly Gly
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Ala Pro Lys Asn Leu Val Trp Glu Ala Val Asn Thr His Gly
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<213> Glycine max

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20 25 30

Asn Leu Phe Asn Arg Lys Gly His Thr Thr Ser Ile Leu Leu Ser Leu
35 40 45

Ile Leu Thr Leu Phe Pro Leu Ser Val Cys Gly Val Leu Phe Ser Asp
50 55 60

Ser Thr Phe Val His Val Leu Ser Ala Ala Leu Ile Gly Phe Leu Trp
65 70 75 80

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Ile Gln Ser Gly Trp Ile Gly His Asp Ser Gly His Tyr Asn Val Met
                 85                  90                  95

Leu Ser Arg Arg Leu Asn Arg Ala Ile Gln Ile Leu Ser Gly Asn Ile
            100                 105                 110

Leu Ala Gly Ile Ser Ile Gly Trp Trp Lys Trp Asn His Asn Ala His
        115                 120                 125

His Ile Ala Cys Asn Ser Leu Asp Tyr Asp Pro Asp Leu Gln His Met
    130                 135                 140

Pro Val Phe Ala Val Ser Ser Arg Phe Phe Asn Ser Ile Thr Ser His
145                 150                 155                 160

Xaa Tyr Gly Arg Lys Xaa Glu Phe Asp Xaa Ile Ala Xaa Phe Leu Ile
                165                 170                 175

Cys Tyr Gln His Phe Thr Phe Tyr Pro Val Met Cys Val Ala Arg Val
            180                 185                 190

Asn Leu Tyr Leu Gln Thr Ile Leu Leu Leu Phe Ser Arg Xaa Lys Val
        195                 200                 205

Gln Asp Arg Ala Leu Asn Ile Met Gly Ile Leu Val Phe Trp Thr Trp
    210                 215                 220

Phe Leu Phe Leu Leu Ala Leu Leu Phe Val Pro Ile Gln His Ile Gln
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Phe Trp Leu Asn His Leu Ala Glu Asn Leu Tyr Xaa Gly
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<210> 7
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<212> DNA
<213> Glycine max

<400> 7

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aaaaaaaaaa aaaa 1934

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<213> Glycine max

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Val Tyr Asn Val Ser Asp Trp Val Lys Glu His Pro Gly Gly Asp Val
35 40 45

Pro Ile Ser Asn Leu Ala Gly Gln Asp Val Thr Asp Ala Phe Ile Ala
50 55 60

Tyr His Pro Gly Thr Ala Trp Ser His Leu Glu Lys Phe Phe Thr Gly
65 70 75 80

Tyr His Leu Ser Asp Phe Lys Val Ser Glu Val Ser Lys Asp Tyr Arg
85 90 95

Lys Leu Ala Ser Glu Phe Ser Lys Leu Gly Leu Phe Asp Thr Lys Gly
100 105 110

His Val Thr Ser Cys Thr Leu Ala Ser Val Ala Val Met Phe Leu Ile
115 120 125

Val Leu Tyr Gly Val Leu Arg Cys Thr Ser Val Trp Ala His Leu Gly
130 135 140

Ser Gly Met Leu Leu Gly Leu Leu Trp Met Gln Ser Ala Tyr Val Gly
145 150 155 160

His Asp Ser Gly His Tyr Val Val Met Thr Thr Asn Gly Phe Asn Lys
165 170 175

Val Ala Gln Ile Leu Ser Gly Asn Cys Leu Thr Gly Ile Ser Ile Ala
180 185 190

Trp Trp Lys Trp Thr His Asn Ala His His Ile Ala Cys Asn Ser Leu
195 200 205

Asp His Asp Pro Asp Leu Gln His Met Pro Val Phe Ala Val Ser Ser
210 215 220

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Arg Phe Phe Asn Ser Ile Thr Ser His Phe Tyr Gly Arg Lys Leu Glu
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Phe Asp Phe Ile Ala Arg Phe Leu Ile Cys Tyr Gln His Phe Thr Phe
                245                 250                 255

Tyr Pro Val Met Cys Val Ala Arg Val Asn Leu Tyr Leu Gln Thr Ile
            260                 265                 270

Leu Leu Leu Phe Ser Arg Arg Lys Val Gln Asp Arg Ala Leu Asn Ile
        275                 280                 285

Met Gly Ile Leu Val Phe Trp Thr Trp Phe Pro Leu Leu Val Ser Cys
    290                 295                 300

Leu Pro Asn Trp Pro Glu Arg Val Met Phe Val Leu Ala Ser Phe Ala
305                 310                 315                 320

Val Cys Ser Ile Gln His Ile Gln Phe Cys Leu Asn His Phe Ala Ala
                325                 330                 335

Asn Val Tyr Val Gly Pro Pro Ser Gly Asn Asp Trp Phe Glu Lys Gln
            340                 345                 350

Thr Ser Gly Thr Leu Asp Ile Ser Cys Ala Ser Ser Met Asp Trp Phe
        355                 360                 365

Phe Gly Gly Leu Gln Phe Gln Leu Glu His His Leu Phe Pro Arg Leu
    370                 375                 380

Pro Arg Cys Gln Leu Arg Lys Ile Ser Pro Leu Val Ser Asp Leu Cys
385                 390                 395                 400

Lys Lys His Asn Leu Pro Tyr Arg Ser Leu Ser Phe Trp Glu Ala Asn
                405                 410                 415

Gln Trp Thr Ile Arg Thr Leu Arg Thr Ala Ala Leu Gln Ala Arg Asp
            420                 425                 430

Leu Thr Asn Pro Ala Pro Lys Asn Leu Leu Trp Glu Ala Val Asn Thr
        435                 440                 445

His Gly
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<213> Triticum aestivum

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cgccaccacc cgggcggcga ggtcccgctc atcaccctcg ccggccagga cgccaccgac  360
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cgcctctccg actacaccgt ccccccccgcc tccgccgact tccgccgcct cctcgcgcag  480
ctctcctccg cgggcctctt cgagcgcgtc ggccacaccc ccaagttcct gctcgtcgca  540
atgtcggtgc tcttctgcat cgccctctac tgcgtcctcg cctgctccag caccggggcc  600
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cacatgttcg ccggcggcct cattggcttc atctggatcc agtcgggctg gattggccat  660
gactccggcc accaccaaat caccaggcac cccgcgctca accgcctcct gcaggtggtc  720
tccgggaact gcctcaccgg cctcggcatc gcctggtgga agttcaacca caacacacac  780
cacatctcct gcaacagcct cgaccatgac ccggacctcc agcacttgcc gctcttcgcg  840
gtttccacca agctcttcaa caacctttgg tcggtctgct acgagcgcac cttggcgttt  900
gatgccatat ccaagttctt cgtcagctac cagcactgga cattctaccc ggtgatggga  960
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gtctcttgcc tgccgaattg gtgggagagg gttgcttttg tgcttgcaag ctttgtgatc 1140
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ccaccaaagg ggaacgactg gtttgagagg caaacagcgg gcacacttga tatcaagtgc 1260
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gatggtttgt agcgtgtata tcctgctgct atggcagctt gaactgcatt ttgggaacat 1920
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<210> 10
<211> 469
<212> PRT
<213> Triticum aestivum

<400> 10

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Met Ala Arg Thr Gly Leu Ala Asp Ala Thr Ala Pro Glu Ala Asp Ala
  1               5                  10                  15

Met Pro Ala Ala Ser Lys Asp Ala Ala Asp Val Arg Met Ile Ser Thr
             20                  25                  30

Lys Glu Leu Gln Ala His Ala Ala Ala Asp Asp Leu Trp Ile Ser Ile
         35                  40                  45

Ser Gly Asp Val Tyr Asp Val Thr Pro Trp Leu Arg His His Pro Gly
     50                  55                  60

Gly Glu Val Pro Leu Ile Thr Leu Ala Gly Gln Asp Ala Thr Asp Ala
 65                  70                  75                  80

Phe Met Ala Tyr His Pro Pro Ser Val Arg Pro Leu Leu Arg Arg Phe
                 85                  90                  95

Phe Val Gly Arg Leu Ser Asp Tyr Thr Val Pro Pro Ala Ser Ala Asp
            100                 105                 110

Phe Arg Arg Leu Leu Ala Gln Leu Ser Ser Ala Gly Leu Phe Glu Arg
        115                 120                 125

Val Gly His Thr Pro Lys Phe Leu Leu Val Ala Met Ser Val Leu Phe
    130                 135                 140

Cys Ile Ala Leu Tyr Cys Val Leu Ala Cys Ser Ser Thr Gly Ala His
145                 150                 155                 160

Met Phe Ala Gly Gly Leu Ile Gly Phe Ile Trp Ile Gln Ser Gly Trp
```

```
                165                 170                 175

Ile Gly His Asp Ser Gly His His Gln Ile Thr Arg His Pro Ala Leu
            180                 185                 190

Asn Arg Leu Leu Gln Val Val Ser Gly Asn Cys Leu Thr Gly Leu Gly
        195                 200                 205

Ile Ala Trp Trp Lys Phe Asn His Asn Thr His His Ile Ser Cys Asn
    210                 215                 220

Ser Leu Asp His Asp Pro Asp Leu Gln His Leu Pro Leu Phe Ala Val
225                 230                 235                 240

Ser Thr Lys Leu Phe Asn Asn Leu Trp Ser Val Cys Tyr Glu Arg Thr
                245                 250                 255

Leu Ala Phe Asp Ala Ile Ser Lys Phe Phe Val Ser Tyr Gln His Trp
            260                 265                 270

Thr Phe Tyr Pro Val Met Gly Phe Ala Arg Ile Asn Leu Leu Val Gln
        275                 280                 285

Ser Ile Val Phe Leu Ile Thr Gln Lys Lys Val Arg Gln Arg Trp Leu
    290                 295                 300

Glu Ile Ala Gly Val Ala Ala Phe Trp Val Trp Tyr Pro Leu Leu Val
305                 310                 315                 320

Ser Cys Leu Pro Asn Trp Trp Glu Arg Val Ala Phe Val Leu Ala Ser
                325                 330                 335

Phe Val Ile Thr Gly Ile Gln His Val Gln Phe Cys Leu Asn His Phe
            340                 345                 350

Ser Ser Ala Val Tyr Val Gly Pro Pro Lys Gly Asn Asp Trp Phe Glu
        355                 360                 365

Arg Gln Thr Ala Gly Thr Leu Asp Ile Lys Cys Ser Pro Trp Met Asp
    370                 375                 380

Trp Phe His Gly Gly Leu Gln Phe Gln Val Glu His His Leu Phe Pro
385                 390                 395                 400

Arg Leu Pro Arg Cys His Tyr Arg Met Val Ala Pro Ile Val Arg Asp
                405                 410                 415

Leu Cys Lys Lys His Gly Leu Ser Tyr Gly Ala Ala Thr Phe Trp Glu
            420                 425                 430

Ala Asn Val Met Thr Trp Lys Thr Leu Arg Ala Ala Ala Leu Gln Ala
        435                 440                 445

Arg Glu Ala Thr Thr Gly Ala Ala Pro Lys Asn Leu Val Trp Glu Ala
    450                 455                 460

Leu Asn Thr His Gly
465
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<210> 11
<211> 448

<212> PRT
<213> Borago officinalis

<400> 11

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Met Ala Ala Gln Ile Lys Lys Tyr Ile Thr Ser Asp Glu Leu Lys Asn
  1               5                  10                  15

His Asp Lys Pro Gly Asp Leu Trp Ile Ser Ile Gln Gly Lys Ala Tyr
             20                  25                  30

Asp Val Ser Asp Trp Val Lys Asp His Pro Gly Gly Ser Phe Pro Leu
         35                  40                  45

Lys Ser Leu Ala Gly Gln Glu Val Thr Asp Ala Phe Val Ala Phe His
     50                  55                  60

Pro Ala Ser Thr Trp Lys Asn Leu Asp Lys Phe Phe Thr Gly Tyr Tyr
 65                  70                  75                  80

Leu Lys Asp Tyr Ser Val Ser Glu Val Ser Lys Asp Tyr Arg Lys Leu
                 85                  90                  95

Val Phe Glu Phe Ser Lys Met Gly Leu Tyr Asp Lys Lys Gly His Ile
            100                 105                 110

Met Phe Ala Thr Leu Cys Phe Ile Ala Met Leu Phe Ala Met Ser Val
        115                 120                 125

Tyr Gly Val Leu Phe Cys Glu Gly Val Leu Val His Leu Phe Ser Gly
    130                 135                 140

Cys Leu Met Gly Phe Leu Trp Ile Gln Ser Gly Trp Ile Gly His Asp
145                 150                 155                 160

Ala Gly His Tyr Met Val Val Ser Asp Ser Arg Leu Asn Lys Phe Met
                165                 170                 175

Gly Ile Phe Ala Ala Asn Cys Leu Ser Gly Ile Ser Ile Gly Trp Trp
            180                 185                 190

Lys Trp Asn His Asn Ala His His Ile Ala Cys Asn Ser Leu Glu Tyr
        195                 200                 205

Asp Pro Asp Leu Gln Tyr Ile Pro Phe Leu Val Val Ser Ser Lys Phe
    210                 215                 220

Phe Gly Ser Leu Thr Ser His Phe Tyr Glu Lys Arg Leu Thr Phe Asp
225                 230                 235                 240

Ser Leu Ser Arg Phe Phe Val Ser Tyr Gln His Trp Thr Phe Tyr Pro
                245                 250                 255

Ile Met Cys Ala Ala Arg Leu Asn Met Tyr Val Gln Ser Leu Ile Met
            260                 265                 270

Leu Leu Thr Lys Arg Asn Val Ser Tyr Arg Ala His Glu Leu Leu Gly
        275                 280                 285

Cys Leu Val Phe Ser Ile Trp Tyr Pro Leu Leu Val Ser Cys Leu Pro
    290                 295                 300
```

```
Asn Trp Gly Glu Arg Ile Met Phe Val Ile Ala Ser Leu Ser Val Thr
305                 310                 315                 320

Gly Met Gln Gln Val Gln Phe Ser Leu Asn His Phe Ser Ser Ser Val
                325                 330                 335

Tyr Val Gly Lys Pro Lys Gly Asn Asn Trp Phe Glu Lys Gln Thr Asp
            340                 345                 350

Gly Thr Leu Asp Ile Ser Cys Pro Pro Trp Met Asp Trp Phe His Gly
        355                 360                 365

Gly Leu Gln Phe Gln Ile Glu His His Leu Phe Pro Lys Met Pro Arg
    370                 375                 380

Cys Asn Leu Arg Lys Ile Ser Pro Tyr Val Ile Glu Leu Cys Lys Lys
385                 390                 395                 400

His Asn Leu Pro Tyr Asn Tyr Ala Ser Phe Ser Lys Ala Asn Glu Met
                405                 410                 415

Thr Leu Arg Thr Leu Arg Asn Thr Ala Leu Gln Ala Arg Asp Ile Thr
            420                 425                 430

Lys Pro Leu Pro Lys Asn Leu Val Trp Glu Ala Leu His Thr His Gly
        435                 440                 445
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<210> 12
<211> 469
<212> PRT
<213> Triticum aestivum

<400> 12

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Met Ala Arg Thr Gly Leu Ala Asp Ala Thr Ala Pro Glu Ala Asp Ala
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Met Pro Ala Ala Ser Lys Asp Ala Ala Asp Val Arg Met Ile Ser Thr
             20                  25                  30

Lys Glu Leu Gln Ala His Ala Ala Ala Asp Asp Leu Trp Ile Ser Ile
         35                  40                  45

Ser Gly Asp Val Tyr Asp Val Thr Pro Trp Leu Arg His His Pro Gly
     50                  55                  60

Gly Glu Val Pro Leu Ile Thr Leu Ala Gly Gln Asp Ala Thr Asp Ala
 65                  70                  75                  80

Phe Met Ala Tyr His Pro Pro Ser Val Arg Pro Leu Leu Arg Arg Phe
                 85                  90                  95

Phe Val Gly Arg Leu Thr Asp Tyr Thr Val Pro Pro Ala Ser Ala Asp
             100                 105                 110

Phe Arg Arg Leu Leu Ala Gln Leu Ser Ser Ala Gly Leu Phe Glu Arg
         115                 120                 125

Val Gly His Thr Pro Lys Phe Leu Leu Val Ala Met Ser Val Leu Phe
     130                 135                 140

Cys Ile Ala Leu Tyr Cys Val Leu Ala Cys Ser Ser Thr Gly Ala His
```

145 150 155 160

Met Phe Ala Gly Gly Leu Ile Gly Phe Ile Trp Ile Gln Ser Gly Trp
165 170 175

Ile Gly His Asp Ser Gly His His Gln Ile Thr Arg His Pro Ala Leu
180 185 190

Asn Arg Leu Leu Gln Val Val Ser Gly Asn Cys Leu Thr Gly Leu Gly
195 200 205

Ile Ala Trp Trp Lys Phe Asn His Asn Thr His His Ile Ser Cys Asn
210 215 220

Ser Leu Asp His Asp Pro Asp Leu Gln His Leu Pro Leu Phe Ala Val
225 230 235 240

Ser Thr Lys Leu Phe Asn Asn Leu Trp Ser Val Cys Tyr Glu Arg Thr
245 250 255

Leu Ala Phe Asp Ala Ile Ser Lys Phe Phe Val Ser Tyr Gln His Trp
260 265 270

Thr Phe Tyr Pro Val Met Gly Phe Ala Arg Ile Asn Leu Leu Val Gln
275 280 285

Ser Ile Val Phe Leu Ile Thr Gln Lys Lys Val Arg Gln Arg Trp Leu
290 295 300

Glu Ile Ala Gly Val Ala Ala Phe Trp Val Trp Tyr Pro Leu Leu Val
305 310 315 320

Ser Cys Leu Pro Asn Trp Trp Glu Arg Val Ala Phe Val Leu Ala Ser
325 330 335

Phe Val Ile Thr Gly Ile Gln His Val Gln Phe Cys Leu Asn His Phe
340 345 350

Ser Ser Ala Val Tyr Val Gly Pro Pro Lys Gly Asn Asp Trp Phe Glu
355 360 365

Arg Gln Thr Ala Gly Thr Leu Asp Ile Lys Cys Ser Pro Trp Met Asp
370 375 380

Trp Phe His Gly Gly Leu Gln Phe Gln Val Glu His His Leu Phe Pro
385 390 395 400

Arg Leu Pro Arg Cys His Tyr Arg Met Val Ala Pro Ile Val Arg Asp
405 410 415

Leu Cys Lys Lys His Gly Leu Ser Tyr Gly Ala Ala Thr Phe Trp Glu
420 425 430

Ala Asn Val Met Thr Trp Lys Thr Leu Arg Ala Ala Ala Leu Gln Ala
435 440 445

Arg Glu Ala Thr Thr Gly Ala Ala Pro Lys Asn Leu Val Trp Glu Ala
450 455 460

Leu Asn Thr His Gly
465

<210> 13
<211> 458
<212> PRT
<213> Helianthus annuus

<400> 13

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Met Val Ser Pro Ser Ile Glu Val Leu Asn Ser Ile Ala Asp Gly Lys
  1               5                  10                  15

Lys Tyr Ile Thr Ser Lys Glu Leu Lys Lys His Asn Asn Pro Asn Asp
             20                  25                  30

Leu Trp Ile Ser Ile Leu Gly Lys Val Tyr Asn Val Thr Glu Trp Ala
         35                  40                  45

Lys Glu His Pro Gly Gly Asp Ala Pro Leu Ile Asn Leu Ala Gly Gln
     50                  55                  60

Asp Val Thr Asp Ala Phe Ile Ala Phe His Pro Gly Thr Ala Trp Lys
 65                  70                  75                  80

His Leu Asp Lys Leu Phe Thr Gly Tyr His Leu Lys Asp Tyr Gln Val
                 85                  90                  95

Ser Asp Ile Ser Arg Asp Tyr Arg Lys Leu Ala Ser Glu Phe Ala Lys
            100                 105                 110

Ala Gly Met Phe Glu Lys Lys Gly His Gly Val Ile Tyr Ser Leu Cys
        115                 120                 125

Phe Val Ser Leu Leu Leu Ser Ala Cys Val Tyr Gly Val Leu Tyr Ser
    130                 135                 140

Gly Ser Phe Trp Ile His Met Leu Ser Gly Ala Ile Leu Gly Leu Ala
145                 150                 155                 160

Trp Met Gln Ile Ala Tyr Leu Gly His Asp Ala Gly His Tyr Gln Met
                165                 170                 175

Met Ala Thr Arg Gly Trp Asn Lys Phe Ala Gly Ile Phe Ile Gly Asn
            180                 185                 190

Cys Ile Thr Gly Ile Ser Ile Ala Trp Trp Lys Trp Thr His Asn Ala
        195                 200                 205

His His Ile Ala Cys Asn Ser Leu Asp Tyr Asp Pro Asp Leu Gln His
    210                 215                 220

Leu Pro Met Leu Ala Val Ser Ser Lys Leu Phe Asn Ser Ile Thr Ser
225                 230                 235                 240

Val Phe Tyr Gly Arg Gln Leu Thr Phe Asp Pro Leu Ala Arg Phe Phe
                245                 250                 255

Val Ser Tyr Gln His Tyr Leu Tyr Tyr Pro Ile Met Cys Val Ala Arg
            260                 265                 270

Val Asn Leu Tyr Leu Gln Thr Ile Leu Leu Leu Ile Ser Lys Arg Lys
        275                 280                 285
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Ile Pro Asp Arg Gly Leu Asn Ile Leu Gly Thr Leu Ile Phe Trp Thr
290 295 300

Trp Phe Pro Leu Leu Val Ser Arg Leu Pro Asn Trp Pro Glu Arg Val
305 310 315 320

Ala Phe Val Leu Val Ser Phe Cys Val Thr Gly Ile Gln His Ile Gln
325 330 335

Phe Thr Leu Asn His Phe Ser Gly Asp Val Tyr Val Gly Pro Pro Lys
340 345 350

Gly Asp Asn Trp Phe Glu Lys Gln Thr Arg Gly Thr Ile Asp Ile Ala
355 360 365

Cys Ser Ser Trp Met Asp Trp Phe Phe Gly Gly Leu Gln Phe Gln Leu
370 375 380

Glu His His Leu Phe Pro Arg Leu Pro Arg Cys His Leu Arg Ser Ile
385 390 395 400

Ser Pro Ile Cys Arg Glu Leu Cys Lys Lys Tyr Asn Leu Pro Tyr Val
405 410 415

Ser Leu Ser Phe Tyr Asp Ala Asn Val Thr Thr Leu Lys Thr Leu Arg
420 425 430

Thr Ala Ala Leu Gln Ala Arg Asp Leu Thr Asn Pro Ala Pro Gln Asn
435 440 445

Leu Ala Trp Glu Ala Phe Asn Thr His Gly
450 455

<210> 14
<211> 35
<212> DNA
<213> Artificial Sequence

<220>
<223> Definition of Artificial Sequence:PCR primer for 5' of pk0011.d5

<400> 14
tttgcggccg caaatcaatg gaagaagcaa agaag 35

<210> 15
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Definition of Sequence: antisense PCR primer for 3' of pk0011.d5

<400> 15
tttgcggccg ccaggattca cccgaaagtg ttc 33

<210> 16
<211> 823
<212> DNA
<213> Triticum aestivum

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<221> unsure
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<220>
<221> unsure
<222> (538)
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<222> (686)
<223> n = A, C, G, or T

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<222> (717)
<223> n = A, C, G, or T

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<222> (777)
<223> n = A, C, G, or T

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<222> (807)
<223> n = A, C, G, or T

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cttcctcctg agtcctgacc acccctcctc gcgctccagc taaatccacg ccaccgatgg 120
cccgcacggg cttcgcggac gcaacggcgc cggaagccga cgcaatgccg gccgccagca 180
aggacgccgc cgacgtccgc atgatctcca ccaaggagct gcaggcgcac gccgccgcgg 240
acgacctctg gatctccatc tccggggacg tctacgacgt cacgcccctgg ctgcgccacc 300
acccgggcgg cgaggtcccg ctcatcaccc tcgccggcca ggacgccacc gacgccttca 360
tggcctacca cccgccctcc gtgcgcccgc tcctccgccg cttcttcgtc ggccgcctca 420
ccgactacac tgtccccccc gcctccgccg acttccgccg cctcctcgcg cagctctcct 480
ccgcgggcct cttcgagcgc gtcggcacac ccccaagttc ctgctcgtcg caaagtcngt 540
gctcttctgc atcggcctct actgctcctc gcctgctcaa caccggggcc acatgttcgc 600
cgggggctca ttggcttatc tggtcagtcg ggctggattg gcatactccg gcacacaaat 660
cacaggcacc tgcctcaacg ctctgnagtg gctcgggaat gctnacggct cggatcnctg 720
gggagtnanc acacaanaca nattctgaan ngtcacatac ctgactcana ttccgtntcg 780
ggtcacaagt ctaaaacttg catcgtnaag acttggttag cat 823

<210> 17
<211> 114
<212> PRT
<213> Triticum aestivum

<400> 17
Met Pro Ala Ala Ser Lys Asp Ala Ala Asp Val Arg Met Ile Ser Thr
1 5 10 15

Lys Glu Leu Gln Ala His Ala Ala Ala Asp Asp Leu Trp Ile Ser Ile
20 25 30

Ser Gly Asp Val Tyr Asp Val Thr Pro Trp Leu Arg His His Pro Gly
35 40 45

Gly Glu Val Pro Leu Ile Thr Leu Ala Gly Gln Asp Ala Thr Asp Ala
50 55 60

Phe Met Ala Tyr His Pro Pro Ser Val Arg Pro Leu Leu Arg Arg Phe
65 70 75 80

Phe Val Gly Arg Leu Thr Asp Tyr Thr Val Pro Pro Ala Ser Ala Asp
85 90 95

Phe Arg Arg Leu Leu Ala Gln Leu Ser Ser Ala Gly Leu Phe Glu Arg
100 105 110

Val Gly